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European Patent Office
Office européen des brevets



(11) Publication number: **0 460 869 A2**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **91304890.6**

(51) Int. Cl.⁵: **G06F 15/40**

(22) Date of filing: **30.05.91**

(30) Priority: **06.06.90 GB 9012601**

(43) Date of publication of application:
11.12.91 Bulletin 91/50

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

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(54) **Data retrieval system, display apparatus and method of recording and displaying.**

(57) An interactive data retrieval system based on a personal computer (10) is provided which comprises a database (8) and a CD-ROM (131) which is arranged to select and display visual images (18) of product literature of interest to a user such as an architect for example. The database contains details of the illustrated products and the manufacturers of the products. A modem is provided to enable the user to communicate with the manufacturers of the displayed products and to receive updating information which is stored in the database. The display of a selected image may be aborted at any time by the user, and in order to facilitate comprehension of the image as quickly as possible whilst maximising the ultimate resolution of the image, the resolution of each displayed image is gradually increased during the display process (Fig. 5). This is achieved by initially displaying the image in the form of blocks of identical pixels. The true image pixels at each position in the blocks are then substituted so as to enhance the resolution of the image. An arrangement for displaying an image which has been scanned at a spatial resolution which is different from the nominal spatial resolution of the monitor is also described (Fig. 8).

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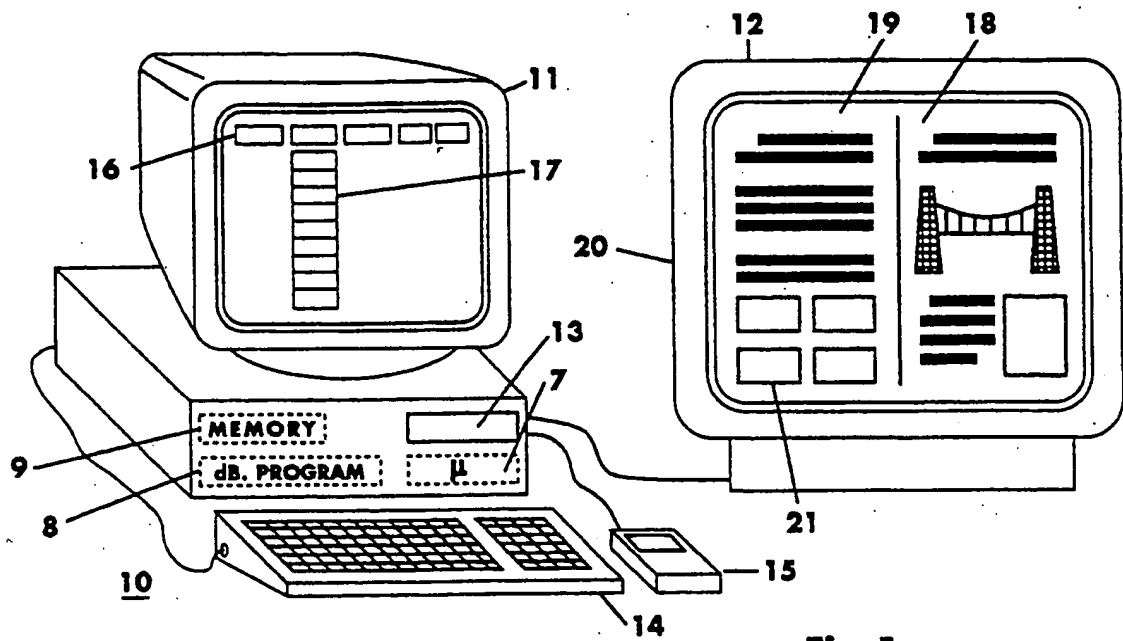


Fig 1

Background of the invention

The present application relates to an interactive data retrieval system, to display apparatus which is suitable for use in such a system, to a digital recording medium which is suitable for use in such a data retrieval system and data display apparatus, and to a method of recording and displaying a still visual image which can be carried out by such a data retrieval system or display apparatus. The present invention relates particularly but not exclusively to such a system, apparatus, recording medium and method when used to handle color images or manufacturers product literature. For example, it is envisaged that such an electronic library will enable architects, quantity surveyors and others to obtain up to the minute information of the products and services offered to the construction industry by manufacturers and suppliers.

One of the main factors which has inhibited the use of electronic data retrieval systems handling color images has been the slow retrieval and display of such images, even when the images are read from a digital recording medium such as a CD-ROM. The various aspects of the present invention are each directed to increasing the speed and/or resolution with which a recorded image (particularly a color image) can be displayed.

Summary of the invention

According to one aspect this invention there is provided an interactive data retrieval system for selectively retrieving and displaying stored visual images, characterised by

- a) a recording medium having a multiplicity of visual images recorded thereon;
- b) playback means arranged to access and read said visual images from said recording medium;
- c) memory means containing a plurality of stored data fields, the data in at least one of said data fields identifying said visual images and the data in at least one other of said data fields being associated with said visual images and relating to users or suppliers of products or data shown in said recorded visual images;
- d) database program means in association with a microprocessor for enabling a user to access data in said data fields and said visual images read by said playback means;
- e) display means arranged to display under the control of said database program means, said visual images and other data accessed by a user; and
- f) an electronic data communications link between the user specified in subparagraph d) and a master database source, or one or more remote users or suppliers of said products or data shown in said recorded visual images. Such an interac-

tive data retrieval system may be implemented, for example using a high speed personal computer equipped with CD-ROM drive and a high resolution color monitor.

The stored visual images may for example show products or data (such as the building regulations for example) available to the construction industry and the stored data associated with the visual images may include manufacturers and suppliers of the products as well as a list of the products and other details appropriate to the construction industry such as the Sfb classification of the products. Conveniently two display means are provided, one, which may be mono for viewing data in said data fields and another, preferably said color monitor for viewing said visual images.

By associating the stored database with the stored visual images the system enables a user such as an architect for example to decide very rapidly which available products would be most suitable for use in any given project. It is envisaged that such a system would be useful not only for architects and other professionals in the construction industry, but for any users of products whose visual appearance is important, or in general as an electronic library.

Such a system has the further advantage that the images of the products literature (which may be stored on CD-disk for example) can be updated very quickly and new CD's can be distributed to the users.

In order to enable a user to obtain more information about any products accessed by the database and displayed on screen, the data retrieval system preferably comprises an electronic data communications link between the local user and a master database source, or one or more remote users, or suppliers of the products or data shown in the recorded visual images.

Preferably, the memory means is arranged to store updating information received via said communications link and relating to a displayed visual image, and said display means is arranged to display said updating information in association with its associated visual image.

Since it will typically take several seconds to display a color image at 75 d.p.i. resolutions of A4 size, the display means is preferably arranged to display each stored visual image selected by the user with a gradually increasing resolution and means are provided for enabling the user to cancel the display of a selected visual image at a stage intermediate the initial relatively low resolution and the final relatively high resolution. For example, the display may be controlled by a mouse or other pointing device and the user may cancel a visual image as soon as it is displayed with a sufficient resolution to enable him to decide that the product shown is of no interest. In this manner, the information retrieved from the recording medium, and hence the display time of each image,

are both optimised.

Accordingly, in a second aspect the invention provides apparatus for displaying a still visual image in the form of a multiplicity of pixels, comprising means for dividing the image into square groups of adjacent pixels, means for replicating a predetermined pixel within each group by the other pixels in that group to form a relatively low resolution image composed of groups of identical adjacent pixels, means for substituting the true image pixels for said other pixels in each group to form a relatively low resolution image composed of individual pixels, and display means responsive to said replicating means and substituting means to display an image of increasing resolution. It should be noted that such display apparatus may be used in applications other than a data retrieval system in accordance with the first aspect of the invention and that the data retrieval system may utilise other techniques for displaying a still visual image with gradually increasing resolution. For example the data retrieval system may be arranged to display a black and white image initially, and to subsequently add color to this image.

In the above-mentioned display apparatus, the substituting means is preferably arranged to substitute the true image pixel for a predetermined one of said other image pixels in each group simultaneously. For example, in a preferred embodiment which is described in detail below, each group comprises a 2 x 2 array of four pixels, the top left-hand pixel is initially replicated within each group and the substituting means first substitutes a true pixel for the bottom right-hand pixel of each group simultaneously, then substitutes a true pixel for the top right-hand pixel of each group simultaneously and finally substitutes the true pixel for each bottom left-hand pixel of each group simultaneously.

Although it will normally be convenient to arrange for each predetermined pixel which is replicated within its group to have the same relative position with respect to the other pixels in its group, for example the top left-hand position in a 2 x 2 array, display apparatus in which these pixels have different relative positions within their respective groups (for example a random or pseudo random relative position) is also within the scope of the invention.

However, in order to enable the preferred display apparatus of the invention to access the pixels in the order in which they are displayed within their respective groups, a feature of the invention provides a digital recording medium having a visual image recorded thereon as groups of pixels, the pixels within each group being adjacent on the recording medium and spaced apart in the visual image such that each pixel belonging to a given group on the recording medium forms part of a group of adjacent pixels of the image and has a predetermined relative position with respect to the other pixels of said group of adjacent pixels

of the image. For example, in a preferred embodiment which is described in more detail below, the recording medium has a group of "top left-hand" pixels adjacent a group of "bottom right-hand" pixels which is adjacent a group of "top right-hand" pixels which in turn is adjacent a group of "bottom left-hand" pixels. Such a recording medium is useful in a display apparatus in accordance with the second aspect of the invention in which the displayed image is initially divided into groups of four pixels (each in the form of a 2 x 2 array), the "top left-hand" pixels from the recording medium being read into the top left-hand positions of respective 2 x 2 arrays and replicated in the remaining three pixels of their respective arrays, and then the "substituting means" substitutes firstly the correct "bottom right-hand" pixels in each 2 x 2 array, then the "top right-hand" pixel in each 2 x 2 array and finally the "bottom left-hand" pixel in each 2 x 2 array.

Typically, it will be desirable to display an A4 image life size in a data retrieval system or display apparatus in accordance with the present invention. However, A4 high resolution color monitors are not commercially available and the problem arises of how best to display such an image on a commercially available color monitor, such as for example a 508 mm (20 inch) color monitor. Furthermore, the pixel size produced by a color scanner will normally be different from the pixel size which a color monitor is adapted to display, and although commercially available scanners may be arranged to scan at predetermined, different, resolutions, this process involves discarding pixels. It has been found that if such a scanned image is displayed on a color monitor then a deterioration in the image quality occurs and in particular, Moiré patterns may be produced.

In order to alleviate the above disadvantages, in a third aspect the present invention provides a method of recording and displaying a still visual image comprising scanning the image with a scanner, recording the scanned image on a recording medium, reading the image recorded on said recording medium and displaying the image by means of a cathode ray tube, wherein the image is scanned at an integer submultiple of the maximum resolution of the scanner, the scanned image being represented by a multiplicity of pixels, and the number of horizontal lines displayed by the cathode ray tube is selected such that there is a one to one correspondence between the horizontal lines and the rows of pixels generated by the scanner.

Preferably the picture width and/or the number of horizontal pixels displayed by the cathode ray tube is adjusted so that the aspect ratio of the displayed image is substantially the same as the aspect ratio of the scanned image.

For example in a preferred embodiment described below, a commercially available color monitor is normally arranged to display images with a pixel

size of 0.396 mm (1/64th of an inch) whereas the scanner is arranged to scan at a resolution of 75 dots per 25.4 mm (75 d.p.i.), corresponding to a pixel size of 0.339 mm. An A4 image scanned at 75 d.p.i. would not fit on the screen if the normal number of horizontal lines were employed. Accordingly, the image is scanned at 75 d.p.i., the number of horizontal lines displayed by the color monitor is increased so as to fit virtually the full height of the document onto the screen, and the picture width displayed by the color monitor is reduced so as to restore the aspect ratio of the document, i.e. so as to ensure that the image displayed has square pixels like those formed by the color scanner.

Brief description of the drawings

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a personal computer (PC) based interactive data retrieval system in accordance with the first aspect of the invention;

Figure 2 is a diagram illustrating the communications between the users of the interactive data retrieval system shown in Figure 1;

Figure 3 shows schematically an optical recording medium in accordance with the feature of the invention;

Figure 4 shows schematically the memory arrangement of a video RAM which is incorporated in the data retrieval system of Figure 1 and which utilises the recording medium of Figure 3;

Figure 5 is a diagrammatic representation of the build-up of an image by a display system in accordance with the second aspect of the invention which utilises the recording medium of Figure 3 and the video RAM arrangement of Figure 4;

Figure 6 is a simplified schematic block diagram of a dedicated graphics controller utilised in the data retrieval system of Figure 1;

Figures 7(a) to (d) show timing diagrams associated with the graphics controller of Figure 6;

Figures 8(a) to (c) illustrate the display of a still visual image by the data retrieval system of Figure 1 from a scanner shown in Figure 8(d), the method of recording and displaying the still visual image being in accordance with the fourth aspect of the invention;

Figures 9 (a)-(e) show initial screens presented by the system of this invention;

Figure 10 shows an alphabetical list of products;

Figure 11 shows a screen of products selected and appropriate manufacturers;

Figure 12 shows the CD-ROM on which the product information is available;

Figure 13 shows a screen of the high resolution

color monitor displaying the product information; Figure 14 shows an alphabetical list of product manufacturers;

Figure 15 shows a screen of details of a particular manufacturer;

Figure 16 shows a screen of Sfb Classification;

Figure 17 shows a screen of a trade name index;

Figure 18 shows a screen of a job file index;

Figure 19 shows a screen of the current building regulations;

Figure 20 shows a screen of image data; and

Figure 21 shows a screen of mail management.

In the Figures like reference numerals denote like parts.

Description of preferred embodiments

The data retrieval system shown in Figure 1 uses an IBM PC/AT compatible computer 10 using an INTEL 80386 SX microprocessor 7. The computer includes a 100 megabytes fast access hard disc 9 and a Phillips (Registered Trade Mark) CD-ROM drive 13. In addition to a conventional relatively low resolution black and white (monochrome) screen 11, the computer includes an additional 20 inch (508 mm) high resolution color screen 12 which is controlled by a dedicated graphics controller (not shown) which is fitted into one of the expansion slots of the computer.

The CD-ROM drive 13 accepts CD-disks containing stored monochrome and color images of manufacturers product literature such as brochures and the like and the computer is loaded with a graphics program which controls the display of these images, one of which is shown in the right-hand half (region 18) of screen 12. Additionally the computer is loaded with a commercially available "Fox pro" database program 8 which has been modified to accept control with a mouse 15, as well as with a conventional key-board 14. The database program enables a user to organise, index, retrieve and display (on mono screen 11) data stored in the database on hard disc. The database consists of manufacturers details (company name, address, telephone, etc.), products details (product categories), brochure details (brochure name, number of pages and details of the block locations of the images stored on the hard disc), and Sfb category details. The Sfb classification system is a widely accepted classification of products used in the construction industry.

Additionally the computer 10 incorporates a modem facility in one of its expansion slots. As shown in Figure 2, this facility enables users of the system to communicate via an electronic mail box such as E-Mail with manufacturers of the products depicted in the brochure images.

Additionally, as shown in Figure 2, the modem enables a system updatér (or master data source) to communicate with a user of a system as shown in Fig-

ure 1 and with other users of similar systems utilising the same database and set of stored brochure images on CD-ROM. Finally, the modem enables diagnostic messages to be sent between the various users and the system updater directly without recourse to any electronic mail box. As shown in Figure 2, it is also assumed that the users and manufacturers can communicate by fax, quite independently of the data retrieval system.

The initial installation takes place at the time each system is commissioned. Thereafter it can be updated in one of three ways:-

- a) By an engineer on-site connecting an extra floppy disk drive to the system and transferring the updates;
- b) When a new set of CD's are issued containing images; part of one CD could be used to store the latest copy of the database;
- c) All the hard disks may be updated by the E-Mail system when users "log-on", e.g. automatically at night, i.e. users need not be present or even aware of the update.

The database also contains references to the brochure images which are stored digitally on video CD-ROM disks. User systems may have a large number of CD's containing tens of thousands of brochure images. Each image is a page of an A4 brochure but may be other desired sizes.

Referring again to Figure 1, it will be seen that screen 11 displays various headings 16. These are as follows:

SELECT INDEX
NOTICE BOARD
MAIL MANAGEMENT
HOUSE-KEEPING
FINISH

The database program is modified to accept control from mouse 15 or another pointing device and accordingly, when a user clicks on one of headings 16 a pull-down menu such as those shown at 17 appears on screen 11 which contains further options which can be selected by the user, using the mouse. The SELECT INDEX menu is as follows:

PRODUCT INDEX
MANUFACTURER INDEX
TRADE NAME INDEX
SfB CLASSIFICATION
BUILDING REGULATIONS
JOB FILE

The JOB FILE option, when selected, calls up a screen which lists image selections initially viewed, that can be saved, messages sent and received and other action taken in connection with any enquiry resulting from the particular file. The BUILDING REGULATIONS options calls up a series of screens in which relevant information on the building regulations is presented. The remaining options in the SELECT INDEX menu each call up a series of

screens listing manufacturers or products according to the relevant classification. These screens in turn each incorporate further options which can be selected by the user using the mouse, including the possibility of calling up images of the brochure pages on section 18 of screen 12.

In this manner, visual images of the products and other product information can be accessed using the various indices provided by the database and the products which are potentially of interest can be grouped together in a job file for further action such as sending an enquiry to the manufacturer. A zoom facility is preferably provided whereby the visual image of a brochure page, which normally occupies part of the viewed screen, may occupy the whole screen. In order to simulate turning the pages of a brochure, the bottom left-hand portion 20 of screen 12 is provided with various icons 21 which can be clicked on using the mouse to select visual images corresponding to different pages of the brochure, for example. The top left-hand portion 19 of screen 12 displays product updating information relating to the products displayed in the visual image on the screen and such information can be transferred to the database hard disk remotely via the modem. In this way, the database system can be updated whilst CD's are being updated to show the latest products.

Information concerning new products and other information of interest to the user can be selected by clicking on the NOTICE BOARD heading on screen 11.

In this manner, architects and others can access reliable, up-to-date information about products likely to be useful in any particular project. The disadvantages associated with product literature in the form of hard copy, namely large amount of storage space, missing or out-of-date information, only one user can view a document at any one time, and difficult access to the required information are thereby avoided. However if hard copy is required, the software enables a user to print out a copy of the image shown in screen portion 18 on a printer known per se (not shown) which may be a color laser printer connected to computer 10.

Hitherto, a disadvantage which has tended to hinder the acceptance of database systems handling color images has been the slowness of retrieval and display of reasonably detailed color images, even using a relatively high speed personal computer. In order to alleviate this problem, the interactive data retrieval system of Figure 1 includes a modification to CD-ROM drive 13, which is described below with reference to Figures 3, 4 and 5.

Figure 4 shows schematically a video RAM 22 which is used to store image pixels read from the CD's by the CD-ROM drive 13. The RAM is divided into a 310 x 428 array of groups of 4 pixels, each group being in the form of a 2 x 2 array. The pixels shown

in the groups can be considered to map onto the pixels displayed in region 18 (Figure 1) of the display so that group 1,1 as shown in Figure 4 occurs at the top left-hand corner of the display, group 310,1 occurs at the top right-hand corner of the display, group 1,428 appears at the bottom left-hand corner of the display and group 310,428 appears at the bottom right-hand corner of the display.

Initially however the video RAM 22 is not filled with pixels in positions 1, 2, 3 and 4 as shown in Figure 4. Instead, all the pixel 1 positions are loaded first and as each pixel is loaded it is copied into positions 2, 3 and 4. For example, if screen pixel 101,101 is a number designated to be red, then on the first pass of the image load, pixels 102,101, 101,102 and 102,102 also become red.

The visual effect of this is that the screen is filled very rapidly with a low resolution version of the final image. As the user assimilates this image, passes 2, 3 and 4 of the load take place.

On pass 2, all the pixel 4 positions are loaded onto the screen overwriting whatever values pass 1 set them to. Thus in each pixel quad, after pass 2, the 2 diametrically opposed pixels of each group contain the correct eventual image information, i.e. the image now contains twice as much visual information as after pass 1. On pass 3, all the pixel 2 positions are loaded onto the screen overwriting their original values - and on pass 4, all the pixel 3 positions are overwritten completing the final image. All 530,720 individual pixels of a 620 x 856 image have now been loaded and the image is now complete.

The purpose of this loading method is as follows: if loaded in a single pass, as is conventional, the user sees a gradual filling of the screen from top to bottom. This takes with current technology about 7 seconds, (i.e. slow to the eye) and if the user were to abort this load when he finally realised that this was not the required image, then a half filled screen would result.

The 4-pass load method of this invention delivers the first whole-screen image (albeit slightly blurred - or low-resolution) in about 1.75 seconds, subsequent passes taking slightly longer. This image should be instantly recognisable as the human brain is excellent at filling in the missing information. This low-resolution image is then sharpened up over the next 3 passes of the load - and the total image load time then becomes 7.5 seconds, i.e. there is a half-second overhead for using this method over the whole image but the user has an earliest opportunity to abort the load and perceives that the image has been loaded in a much smaller timeframe.

This process is illustrated schematically in Figure 5, which shows a small portion of the displayed image 18 as it is built up by the above process. It is assumed that the final image as shown in Figure 5 (d) all the pixels in the group of concern have different colors, shown by different forms of cross-hatching. In the first

pass all the pixels 1-4 of the group are given the color, saturation etc. of pixel 1. The group of 2 x 2 pixels thus appears in the first pass as illustrated in Figure 5 (a).

In the next pass, the replicated pixel in position 4 is given its true color, saturation etc. as shown in Figure 5 (b).

In the third pass, as shown in Figure 5 (c), the correct pixel is written into position 2 of the 2 x 2 array.

Finally, the true pixel is substituted in position 3 of each 2 x 2 array as shown in Figure 5 (d). Thus the user initially sees a slightly blurred picture which his eye-brain combination assimilates as additional detail at each successive pass.

In this invention, the CD-ROM drive 13 and CD-disks 131 (Figure 3) are modified in order to facilitate the above process.

In a conventional CD-ROM drive, data is read from a spiral track on the CD into two sector buffers at a rate of 153 kilobytes per second. These hardware buffers each hold 2 kilobytes of data, and conventionally the data is fed alternatively into one and then the other buffer. This process occurs blindly on a time slice basis. The driver then empties these buffers as fast as possible, delivering the data to the user application.

However with the present invention, a first hardware buffer (labelled A in Figure 3) is filled with all the pixels having position 1 in the 2 x 2 arrays of pixels which constitute the displayed image. These pixels are then copied to video RAM 22 as shown in Figure 4 and are replicated in positions 2, 3 and 4 of each 2 x 2 array 220 as described above. The crude image thus formed (as shown in Figure 5(a) for example) is immediately displayed. Simultaneously, the pixels corresponding to position 4 of each 2 x 2 array are read into a second sector buffer B (Figure 3) and as soon as this buffer has been filled 5 and buffer A has been emptied, these pixels are read into position 4 of video RAM 22 as shown in Figure 4. At this stage, each 2 x 2 array of video RAM 22 has the true image pixel at position 1 replicated at positions 2 and 3 and further has the true image pixel at position 4. At this stage, the contents of video RAM 22 are written to the screen to form a display as shown in Figure 5(b).

Whilst buffer B is being emptied of the pixels of position 4, buffer A is being filled with pixels of position 2 which are read from the CD 131. When buffer A has been filled with the pixels at position 2 and 15 buffer B has been emptied, the pixels of position 2 are read into the appropriate positions of each 2 x 2 array of the video RAM 22 whilst buffer B is filled with pixels of position 3 which are read from the CD 131. When all the pixels in position 3 have been inserted in video RAM 22, the contents of this RAM are displayed to show an image as shown in Figure 5(c).

Finally, the pixels of position 3 stored in buffer B are substituted into the position 3 of each 2 x 2 array

in video RAM 22 and the contents of the RAM (which now comprise the correct image pixels in positions 1, 2, 3 and 4 of each 2 x 2 array) are displayed to form the final high resolution image as shown in Figure 5(d).

In order to facilitate this process the pixels of position 1 are recorded in a leading portion 132 of a recorded track on the CD (shown greatly exaggerated in size for the sake of clarity), followed by the pixels of position 4, the pixels of position 2 and the pixels of position 3 in portions 133, 134 and 135 as shown in Figure 3.

Contrary to usual practice, the visual image data stored on the CD is not compressed in any way. By avoiding compression, the resulting loss of speed associated with decompressing the image is avoided, although compression may be used if desirable.

In order to enable a user to abort the display of any image as soon as he has realised that the image is not wanted, the software checks whether there has been an interrupt from the mouse drive (i.e. whether a mouse button has been pressed and released) after each line of the display has been loaded. If such an interrupt is detected, the loading process is aborted.

Images are stored in two ways on the CD depending upon their color content as decided at the scanning stage. If the image is not absolutely color critical then 1 byte per pixel is used, i.e. each dot in the image points to one of 256 palette entries containing values for red, green and blue (256 levels of red, green and blue). Each pixel can therefore be one of 256 colors from a palette of $256 \times 256 \times 256 = 16.7$ million.

If the image is color critical then two bytes per pixel are used with no palette. 5 bits are used for red, 5 for blue and 5 for green (1 bit spare from the 2 bytes = 15 bits). In this case the image takes up twice the space on disk and one byte per pixel method.

The palette is stored with each image on the CD.

The display of the image read from the CD's by the CD-ROM drive 13 is controlled by a dedicated graphics controller in the form of a 16 bit high resolution graphics card which is fitted into one of the expansion slots (not shown) of the computer 10 (Figure 1). The block schematic diagram of this graphics controller is shown in Figure 6 and its construction and operation will now be described with reference to Figures 6 and 7.

As shown in Figure 6, the graphics controller comprises video RAM 22 (whose function and organisation has already been described with reference to the schematic representation in Figure 4), which is coupled via a memory access arbitration chip 23 directly to the computer bus 25 and also to an advanced cathode ray tube controller chip (ACRTC) 24. Video RAM 22 is also connected to a digital to analogue converter 27 which generates the required red, green and blue signals for the display unit 12 (Figure 1). An overlay detection unit 26 is connected to a

port of video RAM 22 and to the digital to analogue converter (DAC) 27. The overlay detection performed by this unit and also the underlay detection will not be described in detail since these functions are well known per se. These functions are however associated with the menus and any other graphic symbols such as icons 21 (Figure 1) displayed by display unit 12.

The various blocks shown in Figure 6 are described below in more detail.

Video memory 22

The 2Mb of video memory is implemented using dual port video memories. These devices allow drawing and display update to occur simultaneously with the display of the image on the screen. One of the ports is used by the ACRTC or PC to read or write data into the memory, whilst the 20 other is used to read data from the memory to supply the DAC 27.

The memory is arranged in a 1024 by 1024 array, with each pixel being 16 bits deep. Any portion of the 1024 x 1024 array may be displayed on the screen, although normally the resolution would be 1024 x 768.

Digital to analogue converter 27

This device is a Brooktree BT473 chip, which converts the 16 bits of data from the video memory into the analogue red, green and blue (RGB) signals required to drive the monitor 12. The data can be used in 3 different ways to generate a picture on the screen, and these modes of operation are as follows:

1. 15 bit true color mode.

In this mode, bits 0-4 are used to generate the blue output, bits 5-9 generate the green, and bits 10-14 generate the red. Using this mode, up to 32768 different colors may be displayed on the screen at any one time.

2. 8 bit color using a look up table.
In this mode, bits 0-7 are used to address a color look up table. Each look up table entry contains a programmable "palette" of red, green and blue values. Using this mode, 256 different colors from a palette of 16.7 million possible colors can be displayed at any one time.

3. 4 bit overlay using a look up table.

This mode is used in conjunction with either the 8 or 15 bit modes. If bit 15 of any pixel is set to 1, then bits 8-11 are used to address an overlay look up table. Overlay color 0 is always transparent, but colors 1 to 15 can be programmed to generate any of 16.7 million possible colors. These overlays can be used to generate constant color menus and cursors, and allow the software to switch between 8 and 15 bit modes with-

out the menus changing color. Bit 15 of the memory can be thought of as an overlay enable bit.

The DAC 27 is programmed by the computer 10 to select either the 8 or 15 bit mode, by means of a register within the device. Similarly the palette used in the 8 bit mode is also contained in registers within the DAC 27. The detection of bit 15, (which is used to enable the overlays in both modes) is performed by logic which is interfaced to 25 the overlay inputs of the DAC. When bit 15 is 0, the overlay inputs are all forced to logic level 0, whilst if bit 15 is 1, the overlay inputs are set to the level determined by bits 8-11 of the memory data.

Advanced Cathode Ray Tube Controller (ACRTC) 24

The ACRTC is a Hitachi HD63484 specialised graphics chip which can control the display on display unit 12 via programmable registers which must be initialised by the computer 10. These registers allow software to configure the ACRTC in a way that is compatible with the monitor 12 that is being used, and to select the desired display resolution. The ACRTC also initiates the refresh of memory array 22.

Whilst the ACRTC 24 is capable of performing some drawing functions very quickly, many others can be better drawn by the main processor of the computer 10. To cater for this, the memory 22 is interfaced to the ACRTC 24 in such a way that the host computer 10 can directly access the video memory 22. These direct PC accesses are controlled by a memory access arbitration chip 23 in such a manner that they never interfere with the ACRTC accesses.

Memory access arbitration unit 23

This block determines which kind of memory access will be performed if more than 1 access request occurs at any one time. The possible sources of the access can be divided into two groups, viz those initiated by the PC, and those initiated by the ACRTC. The accesses can be further subdivided as follows:

ACRTC access requests:

1. Memory refresh.
2. Video display update.
3. Graphics drawing

PC access requests

1. Memory read/write

The times at which the ACRTC performs its requests are determined in which its internal registers are programmed. However, the times at which the PC tries to access the memory cannot be as easily predicted, and some way has to be devised so that the PC and ACRTC cycles do not clash.

This is done by time slicing accesses to the mem-

ory on a 50-50 basis. The time slicing is done 2 million times a second. Using this scheme, the PC has 500nS to access the memory, followed by 500nS for the ACRTC, 500nS PC, 500 ACRTC etc., 500nS is sufficient time for one PC or ACRTC access cycle to complete.

The ACRTC will, in general, not use all of its time slice periods. It will perform 2 refresh cycles, followed by 2 video display update cycles at the beginning of every line of display. It will then only try to access the memory if a drawing instruction has been issued to it. As a rule of thumb, if the ACRTC is drawing, then the PC will be waiting for the ACRTC to terminate and so will not be attempting to access the memory. Similarly, if the PC is 'drawing' in the memory, then the ACRTC will normally be idle.

In order to maximise performance, if the PC tries to access the memory during the ACRTC's time slice, and the ACRTC is idle, then the PC is allowed to access the memory, and 'hijack' the timeslice. However if the ACRTC is using its timeslice, then the PC is made to wait until its next timeslice (which will occur 500nS later).

The timing diagram shown in Figures 7(a) to (d) illustrate a typical sequence of memory accesses by the ACRTC 24 and the computer 10 as controlled by memory access arbitration unit 23.

At the foot of Figure 7, 14 time slots are shown. The even numbered time slots are assigned to the ACRTC and the odd numbered time slots are assigned to computer 10.

The events occurring in these time slots are as follows:

- 1) No accesses are requested.
- 2) The ACRTC performs a refresh function in its timeslice. The PC requests an access, but is made to wait until the start of its next timeslice.
- 3) The delayed PC access from 2) is performed in the PC timeslice.
- 4) The ACRTC performs another refresh.
- 5) The PC requests, and is granted, an access within its own timeslice.
- 6) The ACRTC performs a display update cycle.
- 7) No accesses are requested.
- 8) The ACRTC performs a display update cycle.
- 9) No accesses are requested.
- 10) The PC requests an access within the ACRTC timeslice. Because the ACRTC is not using its timeslice, the PC access is granted without waiting for the next PC timeslice.
- 11) No accesses are requested.
- 12) The ACRTC performs a drawing cycle in response to a command issued to by the PC.
- 13) No accesses are requested.
- 14) No accesses are requested.

Referring now to Figures 8 (a) to (c), the relationship between the display 12 (Figure 1), the A4 scanned image by a scanner Figure 8(d) and the A4

displayed image is illustrated. As noted above, the display of each image selected by the user is controlled by ACRTC 24 (Figure 6).

Figure 8 (a) shows the relationship between the display screen 12 (which is nominally of resolution 1024 x 768 pixels) and an A4 image 28 displayed life size and occupying a region of 528 x 744 pixels when measured at 64 dots per inch. The monitor 12 has a 20 inch (508 mm) screen (this dimension being measured across the diagonal) and this results in a pixel size of 1/64th of an inch (0.4 mm). Accordingly, it would be theoretically possible to scan an A4 page at a resolution of 64 dots per inch and arrive at a satisfactory display as shown in Figure 7 (a).

In fact it is possible to scan at this resolution using a commercially available color scanner but since the maximum resolution of such a scanner is usually 300 d.p.i., scanning at a resolution which is not a submultiple of this resolution (e.g. 64 d.p.i.) involves arbitrarily discarding certain pixels of the image. This results in a degradation of the quality of the scanned image, and may for example lead to Moiré interference patterns.

Scanning at 60 d.p.i. would avoid this problem, since this resolution is 1/5th of the maximum resolution i.e. an interger submultiple. However it is preferable to scan at a slightly higher resolution and in the data retrieval system of Figure 1 the CD's incorporate images scanned at 75 d.p.i. resolution. Such an A4 scanned image occupies a region of 619 x 872 pixels (approximately) as illustrated in Figure 8 (b). Given the nominal screen resolution of 1024 x 768 pixels, this results in a considerable margin of the A4 image 28 which overlaps the bottom edge of the display area, as shown. Thus such a system as illustrated in Figure 8 (b) could only display part of the height of an A4 scanned image.

In accordance with a third aspect of the invention, this problem is overcome by increasing the number of horizontal lines displayed on screen 12 from 768 to 856 as illustrated in Figure 8 (c). This leaves a discrepancy of 872 minus 856 = 16 pixels in the vertical direction which can be divided into two stripes (illustrated by the cross hatched regions 28a and 28b) at the top and bottom of the A4 image which are just 8 pixels high. In practice, these marginal portions of the image contain no useful information and can therefore be omitted. However because the number of lines (pixels) in the vertical direction has been increased without a concomitant increase in the number of pixels in the horizontal direction, the aspect ratio of the image becomes distorted and in order to restore the correct aspect ratio, the monitor 12 is adjusted so as to reduce the picture width, leaving a blank region 12a (shown cross hatched). Alternatively, the number of pixels in the horizontal direction could be increased from 1024 so as to restore the correct aspect ratio.

The operation of a currently preferred embodi-

ment of the invention (which is not intended to be limiting on the scope and utility of the invention) will now be described in detail.

For architects, consulting engineers and quantity surveyors having the most up-to-date information immediately to hand is vital. For most practices this means maintaining a product library of suppliers literature. However a traditional library has the serious disadvantage that it takes up valuable floor space and often needs the librarian's time and experience to keep it properly organised. But even the most efficient library still does not work properly because of the human factor. An article may be seen in a magazine or brochure and cut out for future reference. In a library that means that no one else can use that same information and that is not the library's only drawback. Many practices use a reference book that is issued annually. Most are limited to several hundred manufacturers references and even when new are about three months out of date. Just before a new issue arrives the publications can thus be up to fifteen months old. What usually happens is the practice gets in touch with the supplier for current information and prices. In a fast moving and competitive business environment these costs and inevitable delays are unacceptable. Despite the traditional library being inefficient and expensive until now there has not been a better alternative. This invention provides, in one embodiment, a product library specially created for architects, consulting engineers, quantity surveyors and everyone involved in the construction industry. These are updated daily, fast and easy to use, low cost and take up only three square feet of floor space; the present invention in a version to be used by the building industry is called the QUANTARC Electronic Library (QUANTARC is a trade mark of the applicants).

The QUANTARC Electronic Library contains over nine thousand manufacturers details, more than a thousand product categories and over twenty-five thousand pages of product information in color. It also includes the latest building regulations as published by Her Majesty's Stationery Office (HMSO) displayed in an easy reference format. All this information is available from this compact system. The personal computer has a 100 megabytes hard disk, a CD-ROM reader, a PC monitor and a twenty inch high resolution monitor on which the color literature is displayed. Inside the system is the autodial modem and all the communications equipment for the system updaters to send automatically the latest update information and for the user to contact the manufacturers. Paper copies of the information is printed out on a high speed black and white laser printer (not shown).

Commands are given to the system by a mouse.

In operation: As soon as a user turns on the system the first screen on monitor 11 asks user to enter their name followed by their own individual pass-word

as is conventional practice. Next, as shown in Fig. 9(a), a user can choose the method by which he wants to search for the information; there are four possible ways. By product category, by manufacturer, by trades name or by Sfb classification. This menu also offers access to building regulations. All four search methods will now be described starting with product category. Firstly the screen shows user an alphabetical list of products covering the whole construction industry. If a user already knows the categories he wants to see he can type in the keyword or a few letters of that category and the system will automatically scan the product categories.

Starting with the alphabetical list. The mouse is used to place the cursor over the product categories user wants to look at and the button on the mouse is pressed. This marks the category. User can mark as many categories as he wishes. When all the product categories have been selected the mouse is clicked on "brochures details". The screen now only shows the product categories user wants to see (Fig. 10). Each category is followed by a list of the brochures available in that category and the manufacturer's name (Fig. 11). User can select and mark the product brochures he wants to look at using the mouse button, just as before. When user has completed his selections, user clicks on the "CD sort" at the bottom of the screen. User brochure selections will be automatically sorted by disk numbers for easy access (Fig. 12). User selects the first disk and inserts it into the reader. User clicks on "view brochures" at the bottom of the screen and page 1 of the first brochure he selected will appear on the color monitor (Fig. 13). Box 151 reminds User he is looking at the first of five brochures selected. To turn the page, User places the cursor over the page forwards or backward boxes 152, 153 and clicks the mouse. The control panel shows User how many pages there are in the brochure and which page he is looking at. The control monitor 11 will show the brochure names User is viewing and indicates the present one with a flashing cursor as indicated by the arrow in Fig. 10. At this stage User can remove the unwanted brochure from the screen using the "discard brochure" button 154. This will automatically remove the brochure and display the next. If the text on any page is especially small User can enlarge any section using a zoom control by pressing a second button on the mouse. In practice, a User will find that even 8 point text is clear and easy to read. If "specification update" 155 flashes, this means that since the page was placed on the library CD-ROM disk the manufacturer has changed the page information. It might be a change in specification, the cancellation of a product or perhaps an introduction of a new one. User places the cursor on the update button 155 and clicks the mouse. The new information is shown in the enlarged section of the screen 156. The update service is available daily, for example by the User dialling

the QUANTARC Electronic Library electronic mail service and all the update information is then stored into user system's hard disk. Also, periodically, the system updater sends the User new CD disks with the updated information incorporated into the relevant pages. At the same time the amended information will also be removed from the update feature of the system.

Suppose that in spite of the details shown in the literature User needs some more information from the manufacturer. With this invention, the "send enquiry" button 157 gives User a choice of four ways to get more information. User can ask for more technical information, arrange for a representative to call, or request a price list and availability by pre-formated messages contained in a letter format. The fourth option, enables user to send a personal free form message to the manufacturer. The addressee's name, address, fax number and greetings as well as the product user is enquiring about are all inserted automatically from the systems' database. Users name, company, address and telephone numbers are all included automatically. All User has to do is type in the details he wants to appear to the body of the letter. The system even adds users name and company at the bottom. The QUANTARC Electronic Library knows the User because he entered his pass-word when he started his session. Messages can be sent by fax or telex by electronic mail service. Messages can be desposited immediately or if user prefers, the system will store them for transmission during the evening when transmission costs are lower. The cursor is placed over "print" button 158 and the whole page of the brochure is laser printed on an A4 sheet.

When the "finished" button 159 is pressed, the system returns to the main menu Fig. 9.

Now, the invention will be described by using the mouse to select the "manufacturer index". The invention shows user the manufacturers in alphabetical order, one screen being shown in Fig. 14. Marking those manufacturers User wants to see, and clicking mouse on "prod dets", and the manufacturers, their products and brochure lists are shown on the screen. Now the system will tell user which CD disk to insert. From this point, the operation is exactly the same as before. User can browse the whole pages in high definition, print them if he wishes and send messages via the enquiry system. The manufacturers' details button takes User into a comprehensive listing of the names and addresses of all the manufacturers together with their telephone and fax numbers and the name of the contact (Fig. 15). It also shows the manufacturers' product and brochure name.

The third method of searching the QUANTARC Electronic Library is by Sfb classification (Fig. 16). If User knows the Sfb classification code, he uses the keyboard search routine to find the classification he wants, marks it, then clicks on "product details" for the

list of brochures and manufacturers. When User has selected those he wants to see, marks them and picks them out, the system will tell User which CD-ROM disk to insert. Once again, User has full screen, high definition and enlargeable images, updates, printing and enquiry facilities to choose from.

The fourth search method allows User to look for the information he requires using the products' trade name (Fig. 17) a feature many Users will find very useful. Once User has marked the trade names, all the features available with the other search methods can be used. The QUANTARC Electronic Library has been designed to meet the specific needs of the construction industry but as will be clear, the invention is not limited to such use and may be used for example by doctors and pharmacies requiring details of medicinal products.

Each User can build up a job file of both manufacturers and products selected for a particular contract. User marks the product selected then they are automatically saved in the job file (Fig. 18). The job file allows quick constant reference without having to go through the search procedures again. Before finishing on the system user is prompted to complete his job file. This allows user to save and print, if required, all or part of the information selected. User gives job file a client name, job number and a project name and it will be filed away until he decides to delete it. A number of job files can be created by each user and can only be accessed by that particular users pass word.

The current building regulations from HMSO can also be searched using screen data (Fig. 19) and image data (Fig. 20). The system allows user to move quickly to the page cross references included in each section by inserting the page number required. To go back to the original page the mouse is clicked on page return.

Another useful system feature is mail management (Fig. 21), selected from the screen of Fig. 9(c)). This is a record of all messages passed to manufacturers through the system. Because it is protected by users pass word it is private.

A notice board (Fig. 9(b)) enables the publisher of the QUANTARC Electronic Library to keep user upto date with information about the QUANTARC system. It is recommended User logs on to E mail once a day just before he closes the system since the system incorporates its own dialling and communication equipment, all the up date information is transferred automatically from the central data base into users system memory, for use the next morning. In a present embodiment, the QUANTARC Electronic Library enables up to 20 users to access the systems with their own pass word. Any changes can be put into the system by a nominated manager.

Internal housekeeping can be organised using the screen of Fig. 9(d).

Finally, closing the system is performed by eject-

ing the CD-ROM disk, pressing finish on the main menu screen (Fig. 9(e)) and the QUANTARC Electronic Library secures all the information, messages and job files until the next day.

Claims

1. An interactive data retrieval system for selectively retrieving and displaying stored visual images (16-21), characterised by
 - a) a recording medium (131) having a multiplicity of visual images recorded thereon;
 - b) playback means (13) arranged to access and read said visual images from said recording medium (131);
 - c) memory means (9) containing a plurality of stored data fields, the data in at least one of said data fields identifying said visual images and the data in at least one other of said data fields being associated with said visual images and relating to users or suppliers of products or data shown in said recorded visual images;
 - d) database program means (8) in association with a microprocessor (7) for enabling a user to access data in said data fields and said visual images read by said playback means (13);
 - e) display means (11, 12) arranged to display under the control of said database program means (8), said visual images and other data accessed by a user; and
 - f) an electronic data communications link (Fig. 2) between the user specified in subparagraph d) and a master database source, or one or more remote users or suppliers of said products or data shown in said recorded visual images.
2. A data retrieval system as claimed in claim 1 wherein said memory means (19) is arranged to store updating information received via said communications link and relating to a displayed visual image (28), and said display means (11, 12) is arranged to display said updating information (19) in association with its associated visual image (18).
3. A data retrieval system as claimed in claim 1 or 2 wherein said visual images (28) recorded on said recording medium are images of the pages of manufacturer's product literature.
4. A data retrieval system as claimed in claim 3 further including a high resolution color monitor (12) for displaying relatively high resolution color images (28) of said pages in addition and a mono-

chrome monitor (11) for displaying to relatively low resolution black and white images of the same pages, the resolution of said black and white images being sufficient for text in said product literature to be legible on said monochrome monitor.

5. A data retrieval system as claim in any preceding claim wherein said playback means (13), memory means (9), data program means (8) are combined in a computer having a separate stored graphics program for controlling the display of said visual images and is arranged to run the data base program of the data base program means and the graphics program sequentially under the control of a user, the graphics program being arranged to display the screen last displayed by the data base program means so as to provide the impression that the data base program is running concurrently with the graphics program.
6. A data retrieval system as claimed in any preceding claim further comprising a computer (10) having a graphics controller (24) for controlling the display of textual data accessed by said database program means (8) and having an additional dedicated graphics controller (22-27) for controlling the display of said visual images (28), said additional graphics controller including video RAM (22) arranged to store a visual image read by said playback means (13) and a dedicated microprocessor (24) which is arranged to control the display of such a visual image stored in said video RAM.
7. A data retrieval system as claimed in claim 6 wherein said video RAM (22) is accessible directly by the main microprocessor (7) of said computer (10) as well as by said dedicated microprocessor (24), and memory access arbitration means (23) are provided which define respective timeslots in which said main and dedicated microprocessors can access said video RAM (22).
8. A data retrieval system as claimed in any preceding claim wherein said recording medium (13) is a digital optical or magneto-optical recording medium.
9. A data retrieval system as claimed in any preceding claim wherein said display means (11, 12) is arranged to display each stored visual image selected by the user with a gradually increasing resolution and means are provided for enabling the user to cancel the display of a selected visual image at a stage intermediate the initial relatively low resolution and the final relatively high resolution.

10. Apparatus for displaying a still visual image (28) in the form of a multiplicity of pixels, comprising means (22, 24, Fig. 3, Fig. 4) for dividing the image (28) into square groups of adjacent pixels (1, 2, 3, 4), means (22) for replicating a predetermined pixel (1) within each group by the other pixels (2, 3, 4) in that group to form a relatively low resolution image composed of groups of identical adjacent pixels, means (24) for substituting the true image pixels for said other pixels in each group to form a relatively high resolution image composed of individual pixels, and display means (12, 22-27, Fig. 5) responsive to said replicating means and substituting means to display an image of increasing resolution.

11. Display apparatus as claimed in claim 10 wherein said substituting means (24) is arranged to substitute the true image pixel for a predetermined one of said other image pixels in each group simultaneously.

12. Display apparatus as claimed in claim 11 wherein said substituting means (24) is arranged to substitute a true pixel for a replicated pixel (4) diagonally in line with said predetermined pixel (1) within each of the groups (220) before substituting a true pixel for any replicated pixel (2, 3) which is horizontally or vertically in line with said predetermined pixel.

13. Display apparatus as claimed in claim 11 or claim 12 wherein each group (220) comprises a 2 x 2 array of four pixels.

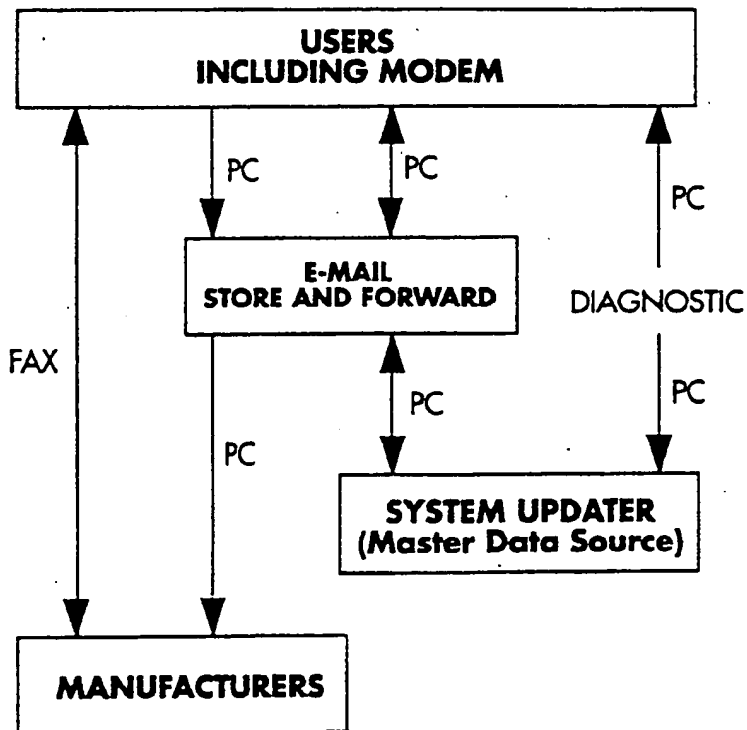
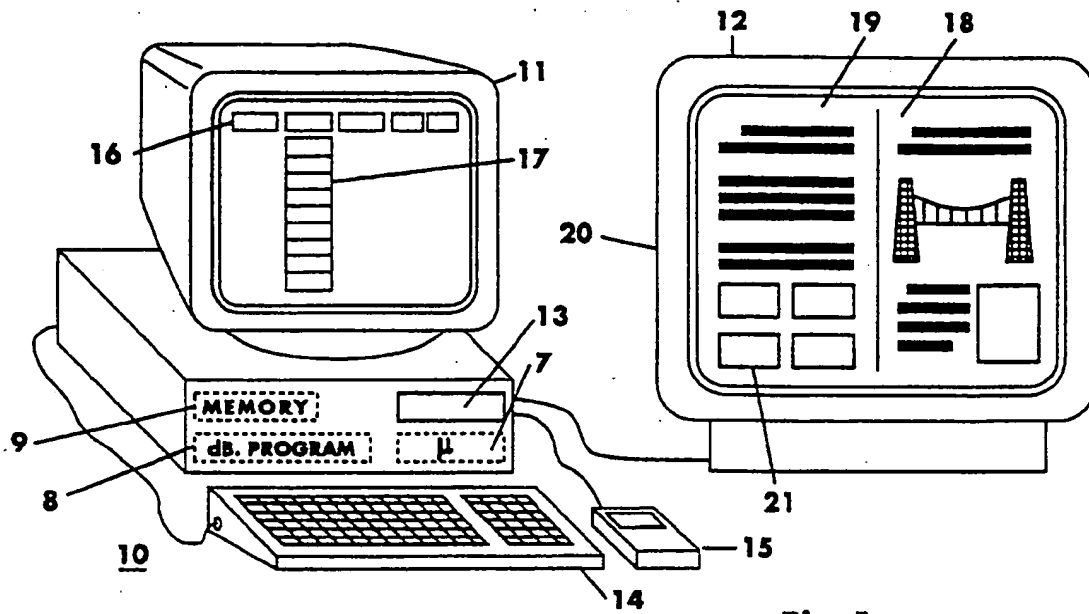
14. Display apparatus as claimed in any of claims 10 to 13 wherein each said predetermined pixel (1) which is replicated within its group (220) has the same relative position with respect to the other pixels (2, 3, 4) in its group.

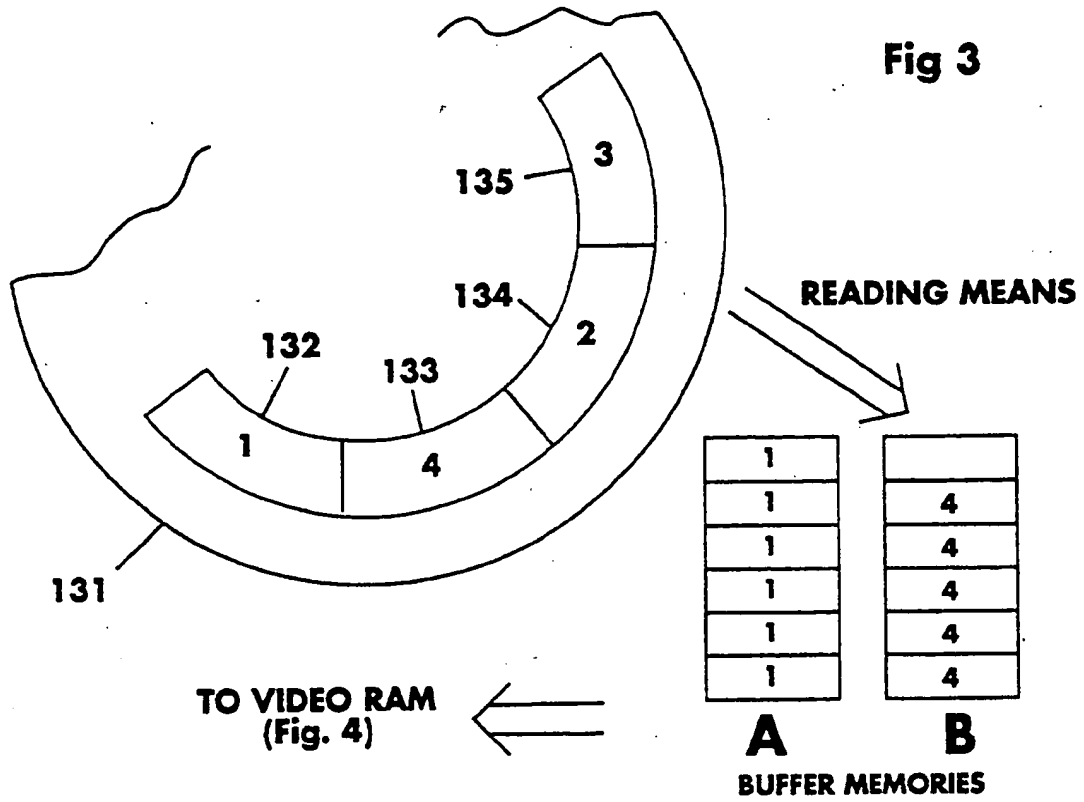
15. Display apparatus as claimed in any of claims 10 to 14 further comprising a recording medium (131) having said image pixel positions recorded thereon and means for reading said recorded image pixels to buffer memory (A, B), said reading means being arranged to read first the predetermined pixels (1) of each group (220) which are to be replicated by the replicating means (24) and subsequently the pixels (2, 3, 4) of each group which are to be substituted by the substituting means (24).

16. Display apparatus as claimed in claim 15 wherein said buffer memory comprises two memory regions (A, B) and said reading means is arranged to read said predetermined pixels (1) of each group (220) into one of said buffer memory regions (A)

and to read the pixels (2, 3, 4) of each group which are to be substituted into the other of said memory regions (B) and said replicating means and substituting means (24) is arranged to operate on the pixels in said one or said other buffer memory region as the case may be whilst pixels are being read into said other or said one buffer memory region.

17. A data retrieval system as claimed in any of claims 1 to 9 which incorporates display apparatus (12, 22-27) for displaying said stored visual images (28) as claimed in any of claims 10 to 16.
18. A data retrieval system as claimed in claim 1 or a display apparatus as claimed in claim 10 including a digital recording medium (131) having a visual image (28) recorded thereon as groups (132-135) of pixels (1-4), the pixels within each group being adjacent on the recording medium and spaced apart in the visual image such that each pixel (1) belonging to a given group on the recording medium forms part of a group (220) of adjacent pixels of the image and has a predetermined relative position with respect to the other pixels (2, 3, 4) of said group (220) of adjacent pixels of the image.
19. A method of recording and displaying a still visual image (28) comprising scanning the image with a scanner (Fig. 8(d)), recording the scanned image on a recording medium (131), reading the image recorded on said recording medium and displaying the image by means of a cathode ray tube (12), wherein the image is scanned at an integer submultiple of the maximum resolution of the scanner, the scanned image being represented by a multiplicity of pixels (1-4), and the number of horizontal lines displayed by the cathode ray tube (12) is selected such that there is a one-to-one correspondence between the horizontal lines and the rows of pixels generated by the scanner.
20. A method as claimed in claim 19 wherein the picture width and/or number of horizontal pixels displayed by the cathode ray tube (12) is adjusted so that the aspect ratio (872/619) of the displayed image (28) is substantially the same as the aspect ratio (744/528) of the scanned image.





GROUP 1,1

1	2
3	4

1	2
3	4

220

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

GROUP 1,428

1	2
3	4

1	2
3	4

1	2
3	4

1	2
3	4

GROUP 310,428

Fig 4

22

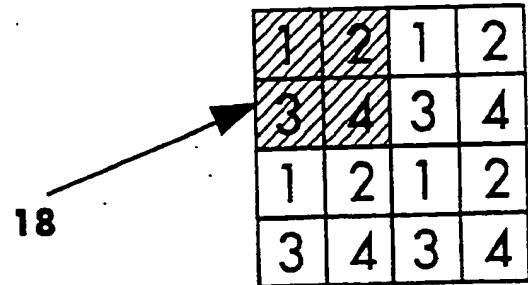


Fig 5(a)

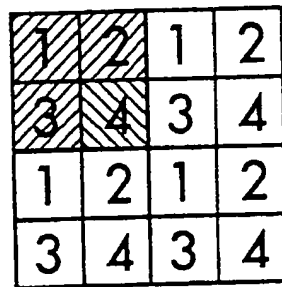


Fig 5(b)

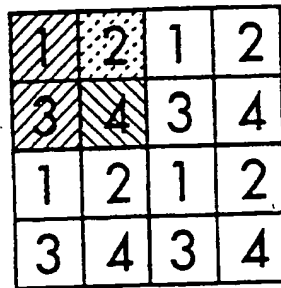


Fig 5(c)

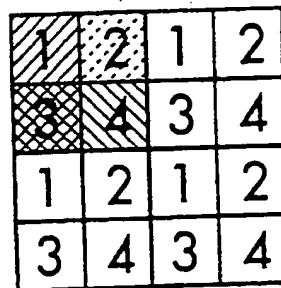


Fig 5(d)

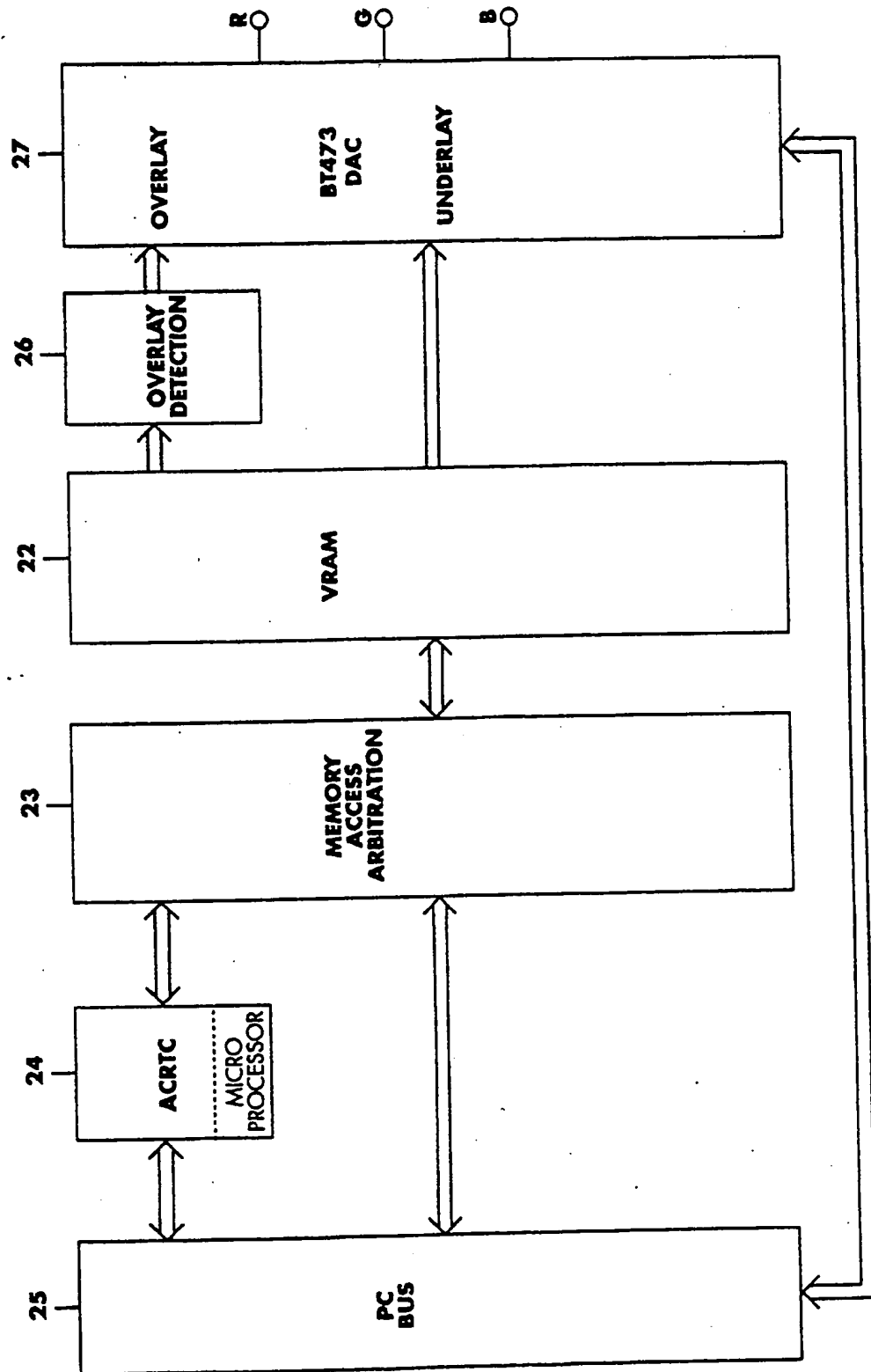
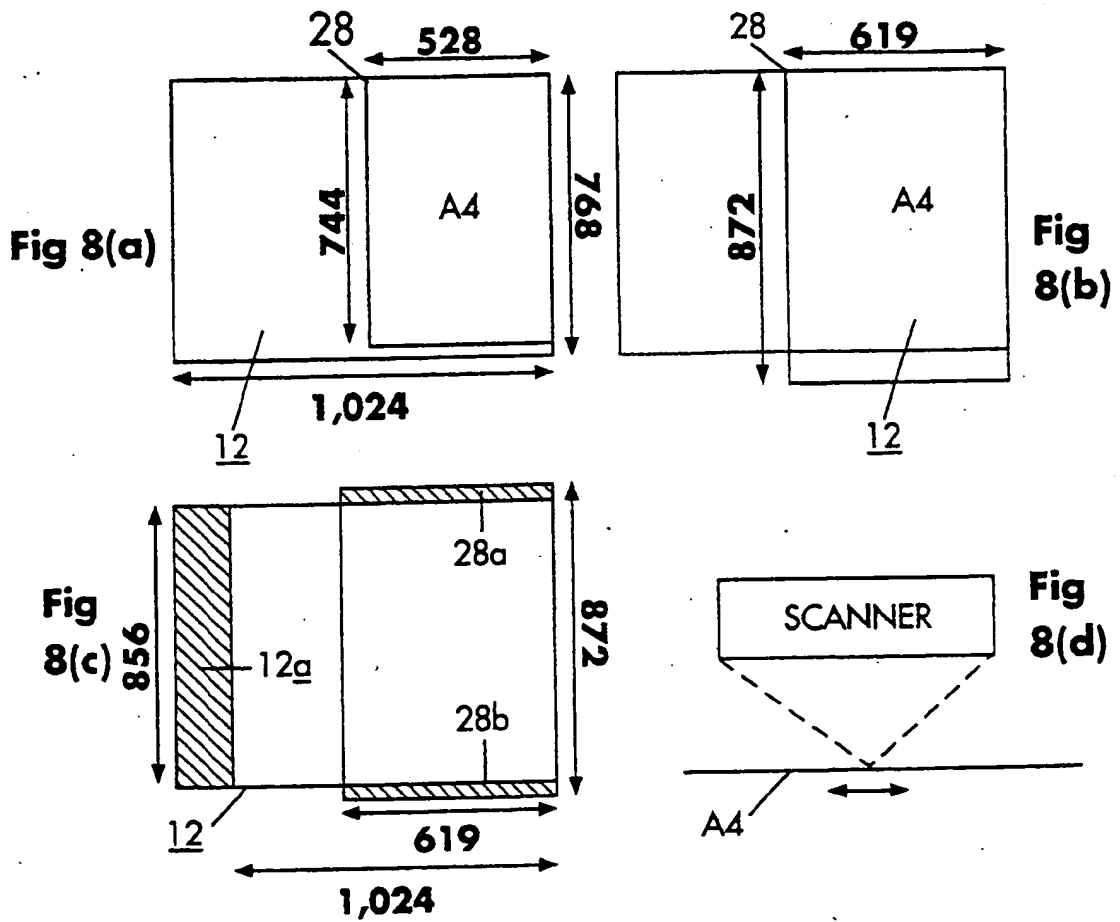
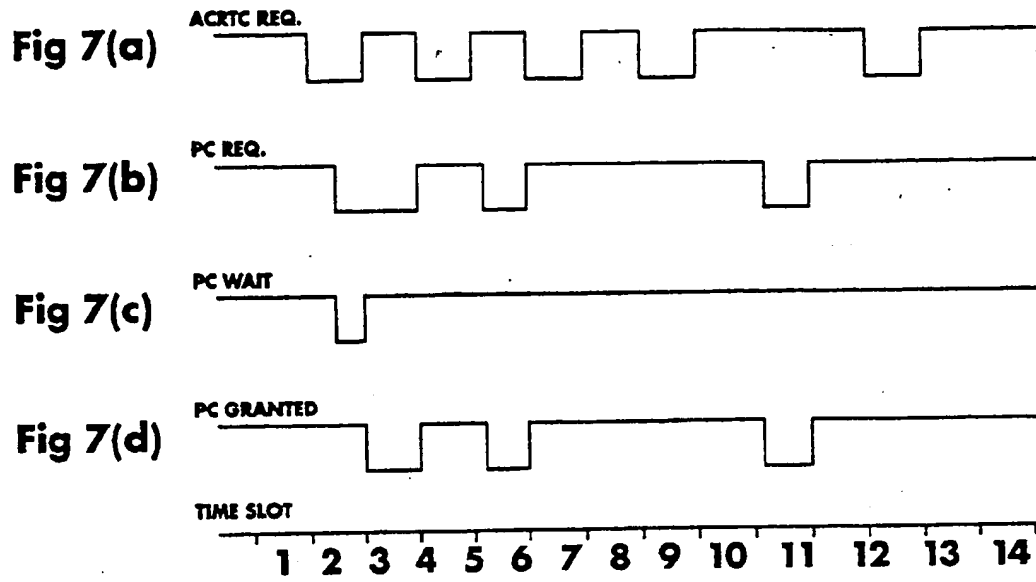


Fig 6



QUANTARC ELECTRONIC LIBRARY				
SELECT INDEX	NOTICE BOARD	MAIL MANAGEMENT	HOUSEKEEPING	FINISH
<div> PRODUCT INDEX MANUFACTURER INDEX TRADE NAME INDEX SYB CLASSIFICATION BUILDING REGS. JOB FILE </div>				
HELP 14:10:50 SELECT MENU/INDEX & CLICK ON WITH MOUSE				

Fig 9 (a)

QUANTARC ELECTRONIC LIBRARY				
SELECT INDEX	NOTICE BOARD	MAIL MANAGEMENT	HOUSEKEEPING	FINISH
<div> USER NOTICES C.D. UPDATES NEW DIGEST </div>				
HELP 14:10:54 SELECT MENU/INDEX & CLICK ON WITH MOUSE				

Fig 9 (b)

QUANTARC ELECTRONIC LIBRARY				
SELECT INDEX	NOTICE BOARD	MAIL MANAGEMENT	HOUSEKEEPING	FINISH
<div> REVIEW SENT MESSG'S COLLECT MESSG'S REVIEW COLLECTED MESSG'S </div>				
HELP 14:11:39 SELECT MENU/INDEX & CLICK ON WITH MOUSE				

Fig 9 (c)

QUANTARC ELECTRONIC LIBRARY				
SELECT INDEX	NOTICE BOARD	MAIL MANAGEMENT	HOUSEKEEPING	FINISH
			<div style="border: 1px solid black; padding: 5px;"> SYST. REGISTRATION PASSWORD COMMS. MGMT. UPDATE C.D. INDEX MAINTAIN USER ACCESS </div>	
<div style="display: flex; justify-content: space-between;"> HELP 14:11:47 SELECT MENU/INDEX & CLICK ON WITH MOUSE </div>				

Fig 9 (d)

QUANTARC ELECTRONIC LIBRARY				
SELECT INDEX	NOTICE BOARD	MAIL MANAGEMENT	HOUSEKEEPING	FINISH
			<div style="border: 1px solid black; padding: 5px;"> Yes No </div>	
<div style="display: flex; justify-content: space-between;"> HELP 14:11:50 SELECT MENU/INDEX & CLICK ON WITH MOUSE </div>				

Fig 9 (e)

QUANTARC ELECTRONIC LIBRARY			
PRODUCT INDEX			
basket strainers, sink basket wastepaper, domestic basket wastepaper, street & park batching plant bath mixers bath/showers taps bathing huts ► bathroom suites baths hospital baths public baths swimming baths swimming equipment baths turkish baths waste pipes baths, sauna public bats insulating batterboard			
HELP	ALPHA SEARCH:	BROCHURE DETAILS	FINISH

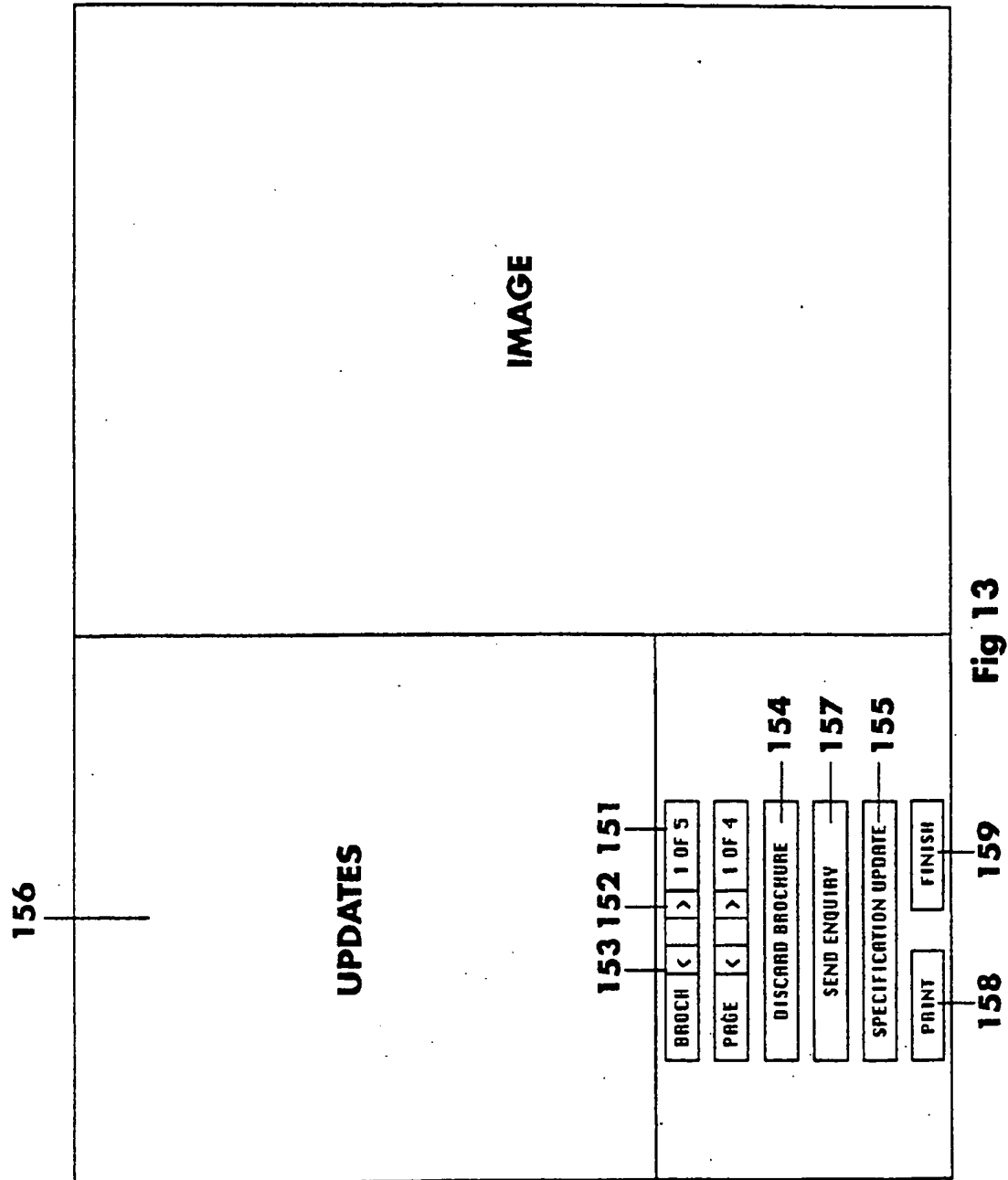
Fig 10

QUANTARC ELECTRONIC LIBRARY	
PRODUCTS/BROCHURES SELECTED	
Product/Brochure	Manufacturer
DRAINAGE BELOW GROUND	
♥ Channel Drainage	Wade International (UK) Ltd
♥ Floor Drains	Wade International (UK) Ltd
INSULATION PRODUCTS, BOARDS	
♥ Crown and Rocksil	Kitson Insulation Products
♥ Crown Pipe Insulation	Kitson Insulation Products
♥ Crown Slabs	Kitson Insulation Products
PAVING EXTERNAL	
♥ Nori Clay Pavers	Marshalls Mono Ltd
♥ Paving	Marshalls Mono Ltd
HELP	C.D. SORT
EDIT FINISH	

Fig 11

QUANTARC ELECTRONIC LIBRARY	
PRODUCTS/BROCHURES SELECTED	
Product/Brochure	Manufacturer
DRAINAGE BELOW GROUND	
► Channel Drainage	Wade International (UK) Ltd
► Floor Drains	Wade International (UK) Ltd
INSULATION PRODUCTS, BOARDS	
♥ Crown and Rocksil	Kitson Insulation Products
♥ Crown Pipe Insulation	Kitson Insulation Products
♥ Crown Slabs	Kitson Insulation Products
PAVING EXTERNAL	
♥ Nori Clay Pavers	Marshalls Mono Ltd
♥ Paving	Marshalls Mono Ltd
HELP	C.D. SORT
EDIT	FINISH

Fig 12



QUANTARC ELECTRONIC LIBRARY			
MANUFACTURER'S INDEX			
Arkes Equipment Ltd Arken (UK) Ltd Arkinatall Cloakroom Equipment Ltd Arkinatall Galvanizing Ltd Arkrose Ltd Arkwright Architectural Aluminium Arlen Electronics Ltd Arm Marketing Ltd Armac Engineering Co Ltd Armedillo Products Ltd Armca Specialties Ltd Armaco Construction Products Ltd Armes, R J & Sons Ltd Armifibre Ltd ▶ Armitage Shanks Ltd Armitage Shanks Ltd Engineering Division Armitage, George & Sons plc			
HELP	ALPHA SEARCH:	PROD DTLS	MANUF DTLS FINISH

Fig 14

QUANTARC ELECTRONIC LIBRARY			
MANUFACTURER DETAILS			
Name Armitage Shanks Ltd			
Address Armitage RUGELEY Staffordshire WS15 4BT England	<table><tr><th>Products overview</th></tr><tr><td>BATHROOM SUITES Clarendon Range Dolphin Range Vanity Units</td></tr></table>	Products overview	BATHROOM SUITES Clarendon Range Dolphin Range Vanity Units
Products overview			
BATHROOM SUITES Clarendon Range Dolphin Range Vanity Units			
Phone 0543 490253 Fax 0543 491677 Telex 339781			
Contact Mr K Hancock Job Title Marketing Director			
HELP	PRINT NEXT TO INDEX FINISH		

Fig 15

QUANTARC ELECTRONIC LIBRARY			
Sfb CLASSIFICATION			
(82)	office furniture & fittings		
(82)	printing machines drawing office		
(82)	reprographic equipment		
(82)	safes office		
(82)	seats office		
(82)	shelves & shelving office		
(82)	storage, bulk office		
(82)	telephone kiosks, internal		
(82)	typewriting & typewriters		
(82)Abb	abattoir fittings and equip		
(82)bank	bank safes, fittings, screens		
(82)bank	night safes		
(82)bank	safes security		
(82)bank	strong rooms		
(82)bank	wall safes		
(82)int	office landscaping services		
(82)int	plant displays, interior		
HELP	ALPHA SEARCH:	PRODUCT DETAILS	FINISH

Fig 16

QUANTARC ELECTRONIC LIBRARY			
TRADE NAME INDEX			
NIL-SPORE VIC-VAC 'S' RANGE 'T' GRADE SEAL 'T' SERIES 'T' VENTS 004 SECURITY FILM 10 STRIP 1040 SLIDING 1890's 1ST THERMAL (USA) 200 SERIES 2000 2200 ANTISTAT 2200 RD 24 HOUR 2L2			
HELP	ALPHA SEARCH:	BROCHURE DETAILS	FINISH

Fig 17

QUANTARC ELECTRONIC LIBRARY				
JOB FILE				
CLIENT Leeds City				
PROJECT Headingley Centre				
Product/Brochure	Manufacturer	Mess Sent	Date	
INSULATION				
Crown and Rocksil	Kitson Insulation Products			
Crown Pipe Insulation	Kitson Insulation Products	1		
DRAINAGE				
Channel Drainage	Wade International (UK) Ltd	4		
PAVINGS				
Nori Clay Pavers	Marshall's Mono Ltd	2		
BATHROOM SUITES				
HELP	PRINT	FILE	FILE & MESSAGES	MESSAGES. FINISH

Fig 18

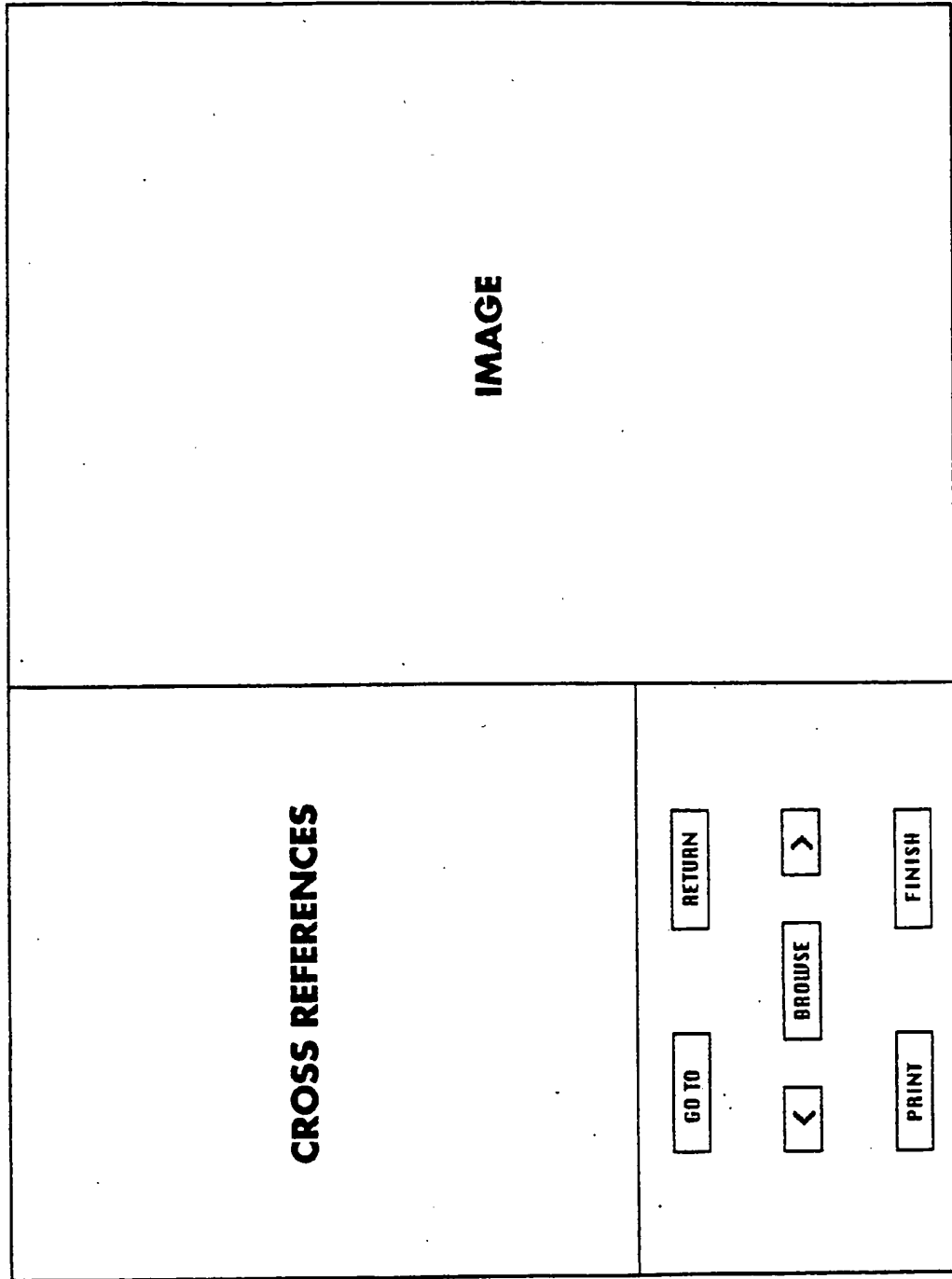


Fig 19

QUANTARC ELECTRONIC LIBRARY	
BUILDING REGULATIONS	
Building Regulations Index	Page
INTRODUCTION	2
Do The Building Regulations apply?	3
Which procedure to follow if The Building Regulations apply	
Meeting the requirements of The Building Regulations	5
SECTION 1	
The application of The Building Regulations	6
SECTION 2	
The Two systems of building control	7
A LOCAL AUTHORITY CONTROL	7
Deposit of plans	7
Certificates of compliance	8
Building in accordance with plans	8
HELP	VIEW FINISH

Fig 20

QUANTARC ELECTRONIC LIBRARY			
REVIEW SENT MESSAGES			
MESSAGES SENT			
	Manufacturer	Mess Sent	Date
INSULATION			
Crown and Rocksil	Kitson Insulation Products	2	30/5/90
Crown Pipe Insulation	Kitson Insulation Products	3	30/5/90
DRAINAGE			
Channel Drainage	Wade International (UK) Ltd	4	30/5/90
PAVINGS			
Nori Clay Pavers	Marshall's Mono Ltd	1	30/5/90
BATHROOM SUITES			
Clarendon Range	Armitage Shanks Ltd	1	30/5/90
HELP			FINISH

Fig 21